JUNE 20, 1983

CHEMICAL & ENGINEERING

NEWS

Scientists explain rationale behind major new nuclear arms initiatives
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Plastics monomers enjoy brisk recovery

A Key Chemicals Review Page 16

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Cover: PPG Industries' vinyl chloride plant, Lake Charles, La.

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CHEMICAL & ENGINEERING
NEWS
JUNE 20, 1983

News of the Week

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■ **Four scientists win General Motors awards for their contributions to cancer research.** **Page 5**

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Plastics Intermediates Are Rebounding Strongly

To producers' surprise, vinyl chloride, styrene, and toluene diisocyanate use is growing fast; rate could slow a bit later in year

Bruce F. Greek, C&EN Houston

This year as usual, business forecasts have been wrong about plastics intermediates, but this time the error is a happy one. Instead of slowly struggling out of the recessionary quagmire from 1982, plastics starting materials such as the three in the following pages—vinyl chloride, styrene, and toluene diisocyanate (TDI)—are rolling toward mid-1983 at an impressive clip. Although producers figure the current rate very likely could throttle back in late 1983 and 1984, they are still pleased at their best market situation since 1979.

There's some variation in the fortunes of these chemicals. One, TDI, appears close to a supply crunch in its polyurethane market that could last two years or more. Vinyl chloride and styrene have plenty of surplus capacity still, though at higher prices, so they could handle demand growth through 1984 and beyond.

All producers of these intermediates have responded as expected to the strong upsurge in demand—they have raised prices. They probably will raise them even more later this year, partly to continue the new profitability gains, but also to pass on cost increases, some that producers had to absorb in the dismal days of 1982.

Key Chemicals

The higher tags, often in the form of reduced or rescinded discounts, will push up estimated combined 1983 value for these three chemicals nearly $400 million or 18% to $3.9 billion.

Combined production will rise considerably less. Estimates taking into account a slowing growth rate later in the year total a bit more than 14 billion lb, up 8% from 1982.

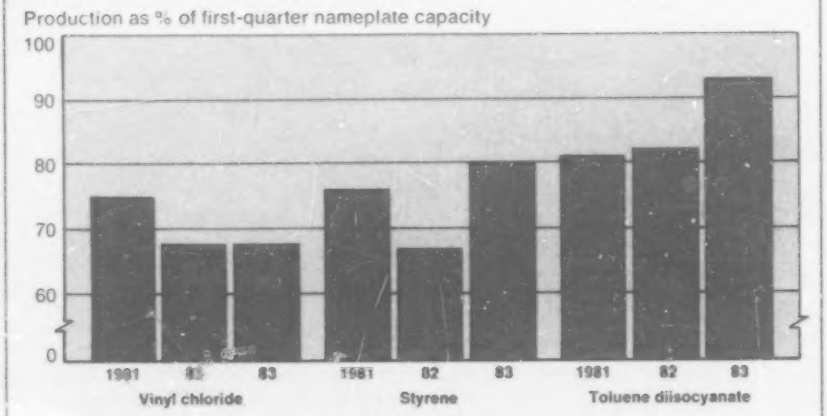
Although hardly displeased with their newly revalued chemicals, producers are still a bit nervous about the current business pace. The production pipeline from chemicals to plastics to end markets has a strong enough momentum now to get producers into trouble if demand in important areas such as housing and autos takes any sudden turn.

Although no radical declines in housing or auto sales are expected later in 1983 or in 1984, the current upswing could yield to a leveling off. If something like this happens, producers worry that inventories may start to look too big in view of their carrying costs. This would lead to some trimming and a marked effect on growth rates in the intermediates. Part of the current problem is that the coming summer months, seasonally slower than the spring, could mask the real situation and fool producers up and down the market chain into believing that the first-half clip will continue after a slight hot-weather pause.

So the fourth quarter of 1983 looms as an important test for the whole U.S. economic recovery and certainly for plastics materials' role in it. Questions involved will include the wisdom of closing more old capacity in vinyl chloride and styrene, the need to schedule construction of new capacity, and the always tricky matter of end-of-the-year tax adjustments in inventories.

For now, many industry voices hope that the new business wave won't boomerang in an overdone sequence of inventory building, capacity expansion, and then painful adjustments in a cooled-off economy. First-half 1983 has been good to plastics materials people, and they want to keep it that way.

Plant use up sharply in styrene, toluene diisocyanate



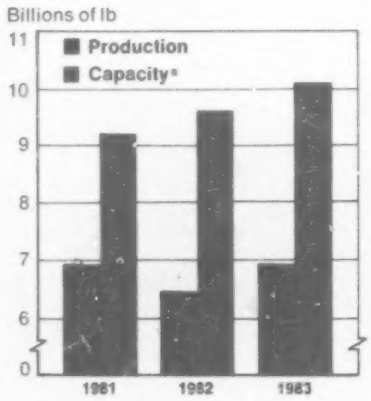
Sources: International Trade Commission, industry and C&EN estimates

Vinyl Chloride

$CH_2=CHCl$

- ***Demand rebounding***
- ***Capacity due down***
- ***Prices going up***

PRODUCTION/CAPACITY



[a] First quarter.

HOW MADE

Dehydrochlorination of ethylene dichloride made by reacting chlorine with ethylene

MAJOR DERIVATIVES (U.S.)

Vinyl polymers nearly 100%

MAJOR END USES (U.S.)

Fabricated plastic items nearly 100%

FOREIGN TRADE

Exports—may decline in 1983 to about 800 million lb, imports—less than 100 million lb

PRICES

List price 22 cents per lb and scheduled to rise

COMMERCIAL VALUE

$1.3 billion for production, 1983

After suffering more than U.S. producers thought possible in last year's recession, vinyl chloride is doing better in 1983. Producers are considerably buoyed by the prospects. One sure sign is their attempt at the moment to raise list prices after enduring discounts of one third or more 12 months ago.

Production this year has a shot at the old record of 6.9 billion lb in 1981 and 1978. One expert who thinks a new sales peak could be in view points out that production went up substantially in the first quarter and demand prospects are still improving.

But vinyl chloride does have some problems—not considered serious by optimists but thought a potential drag by pessimists. One of the top concerns is a "cost push" from behind. Raw material chlorine producers are agitating for a big price increase at the moment, under pressure from falling markets for chlorine's coproduct, caustic soda. Chlorine price increases already have been widespread and may continue later this year. These reflect costs of chlorine's electrochemical production units, which continued to rise as energy and other costs rose even in the recession. Because vinyl chloride's molecular weight is more than half chlorine, a price increase for chlorine quickly turns into price increases for vinyl chloride.

Currently, list prices for vinyl chloride run 22 cents a lb, but there's an effort under way to raise them to 25 cents a lb. Heavy temporary voluntary allowances (official discounts) a year ago had prices down as much as 14 cents. Currently, discounting continues from the 22-cent level but not nearly as much as in 1982.

Vinyl chloride's other raw material, ethylene, also had a price hike this spring, though not as much. Ethylene prices are scheduled to go up again, perhaps as much as 10% in the third quarter. This coming boost, coupled with the recent chlorine price action, is behind the price push in vinyl chloride. Another one could be due later in 1983 as producers continue to pass on cost increases.

In the face of these cost increases, vinyl chloride producers may have a suspenseful time on profitability this year. Presumably, in raising their own prices, producers are including something for themselves in addition to passing along cost increases. But the market may have something to say about how much of a price increase makes it before demand growth starts to flag.

Even with such a potential damper, the mid-range outlook for 1983 vinyl chloride production is for a 6% increase from 1982 production of 6.5 billion lb. The range of production estimates isn't as broad as for some other major organic chemicals, going from a low of 6.7 billion lb (3% gain) to a high of 7.1 billion lb (8% gain).

Vinyl chloride's plant operating rates also are headed up, in fact, faster than production. The major reason is permanent shutdown of Shell's vinyl chloride unit at Norco, La., taking away 700 million lb of capacity. Slightly offsetting this will be 300 million lb of added capacity later this year at Du Pont (Conoco) at Lake Charles, La. So for the year, available (although not necessarily operting) nameplate capacity appears to balance out at about 9.5 billion lb. The operating rate on this basis will be more than 72%. However, more realistically, the effective operating rate will hit 80% or more, given temporary plant shutdowns and vinyl chloride's somewhat lower than average effective top operating rate.

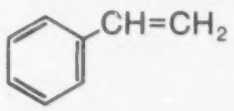
Powering the use rate increase will be a hefty U.S. market rebound. Demand in the U.S. will increase more than will production because exports are forecast to fall 100 million lb or so from more than 900 million lb in 1982.

Demand for polyvinyl chloride, which accounts for practically all vinyl chloride use, is rising on the strength of the general economic recovery, especially in housing (C&EN, April 18, page 11). About the only concern is potential trouble from overdone inventory building of fabricated PVC products such as pipe and fittings. If inventories get out of hand and interest rates continue to creep up, inventory cutting in 1984 could hurt further growth for vinyl chloride.

For 1983, however, vinyl chloride producers seem likely to have a much improved year over 1982 in both demand and profitability. And these important marketing factors are unlikely to spur a round of capacity additions for at least two more years.

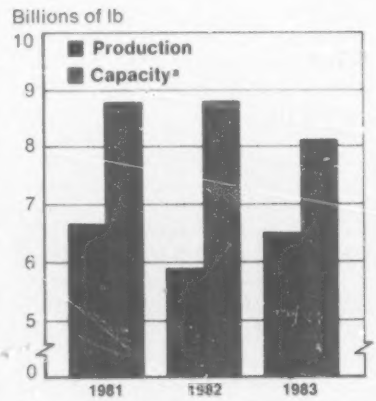
Key Polymers

Styrene



- ***Demand recovering***
- ***Capacity down***
- ***Prices firming***

PRODUCTION/CAPACITY



a First quarter.

HOW MADE

Dehydrogenation of ethylbenzene, made either from ethylene and benzene or recovered from petroleum reformate; coproduction with propylene oxide

MAJOR DERIVATIVES (U.S.)

Plastics-oriented polymers 85%, styrene-butadiene rubber 10%

FOREIGN TRADE

Exports—may rise 5% in 1983 to more than 1 billion lb, imports—25 million to 50 million lb

PRICES

List prices 32 to 36 cents per lb

COMMERCIAL VALUE

$2 billion for production, 1983

Styrene looked for a while like a laggard in the current U.S. economic recovery. But then spring come along, and styrene took off. It now seems to be making up for lost time, with demand strong and prices firming again for the beginning of the third quarter.

The jump in reported production in March was spectacular. Including some estimated data, the U.S. International Trade Commission puts March production at 578 million lb, up more than 140 million lb from February. Even allowing 10% more production for the longer month, the rise in March was greater than expected.

Some slumping then occurred in April, sources say, but May output apparently again came on strong. By this time, styrene's recovery had become clear and prices firmed, spurred partly by increases in raw material benzene prices. Current list prices have reached 32 cents a lb minimum through elimination of temporary voluntary allowances (official discounts). Actual selling prices have gone up even more than list prices, so discounts are shrinking fast.

Discounting in styrene's price might become negligible in the third quarter, according to some optimists. Supplies are widely reported as becoming tighter, and there are plans for plant shutdowns for maintenance this summer.

Still, styrene is in no danger of shortage. Although capacity has decreased because older, inefficient plants were shut down during the recession, plenty of capacity remains if it is operated. And no real tightness in supplies of raw material benzene or ethylene will occur for quite some time.

As 1983 began, operable styrene capacity exceeded 8 billion lb per year. Not all of it was operating at the time, but all is expected to be running for the second half of the year. No additional capacity, except for possible debottlenecking, will become available in 1983. In fact, major expansion could be some time off. Even if planning firmed up now, the earliest on-stream dates for new capacity would be toward the end of 1985 or in 1986.

Opinion varies a lot on 1983 styrene production. Pessimists cite the first-quarter output of 1.4 billion lb as a drag for the year and call for an overall gain of just 5% to 6.2 billion lb from 1982. Optimists, however, look at the robust March figure and believe that things will be even better in the second half. They call for a 1983 total of 7 billion lb. Average opinion now looks for a 10% gain to about 6.5 billion lb.

If production hits this level, plants will operate at an average rate of 80%. Clearly, capacity will not be strained even if temporary shutdowns take out another two to four weeks of production.

Still, breaking the 80% level certainly will help this business, badly depressed until recently. A production upturn in 1983 would be the first in four years since the previous high in 1979 of 7.5 billion lb.

Styrene's production pickup is the result of a combination of demand gains in all major use segments and of some inventory building. The major end use, polymers (mainly polystyrene), probably will not show a full 10% gain for 1983 but could surprise producers with end-of-the year strength, some analysts think.

At present, inventories of styrenic polymers are moving up, helping increase demand for styrene. Use of the co- and terpolymers, such as acrylonitrile-butadiene-styrene, might gain more than 10% because of their relatively smaller size and greater damage in the recession.

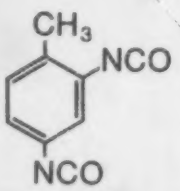
Styrene-butadiene rubber and latexes also have shown signs of a strong recovery. Here, auto production and replacement tire sales are helping more than expected earlier in the year. Carpet-backing use of these polymers is also picking up as a result of the upswing in home building.

By contrast, exports of styrene might be in for their last gala time in 1983 with a rise to as much as 1.15 billion lb. Of course, a looming loss of exports has been forecast before, because of new foreign plants, but it's anybody's guess whether 1984 will be the beginning. For 1983, export strength in volume and in prices still will help U.S. styrene producers.

So styrene will get market help across the board this year, in the U.S. and abroad. That can't yet make the year another 1979, but at least styrene is beginning to make money again.

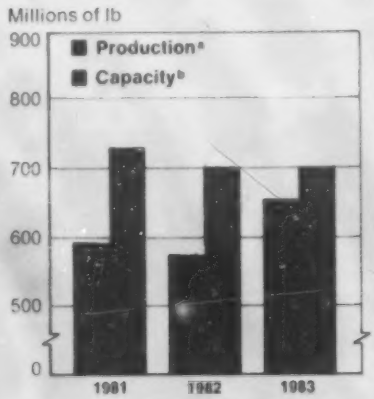
Key Polymers

Toluene Diisocyanate



- ***Demand up strongly***
- ***Capacity flat***
- ***Prices firm***

PRODUCTION/CAPACITY



a Mainly 80/20% mixtures of 2,4- and 2,6-isomers. b First quarter.

HOW MADE

Nitration of toluene, followed by reduction to diamine, reaction with phosgene, purification, and recovery of coproduct hydrochloric acid

MAJOR DERIVATIVES (U.S.)

Polyurethanes almost 100%

MAJOR ENDS USES (U.S.)

Flexible polyurethane foams 90%, polyurethane coatings 5%

FOREIGN TRADE

Exports—to hold around 190 million lb in 1983, imports—negligible

PRICES

List price 93 cents per lb

COMMERCIAL VALUE

$600 million for production, 1983

Toluene diisocyanate producers are sitting pretty. They had one of the easiest passages in the U.S. chemical industry in last year's recession, and this year, supply of their product is already getting tight. Although TDI is somewhat of a statistical fugitive—data on both production and capacity aren't considered very exact—it's apparent that plant use is quite high.

Recovery from the recession started early, beginning in late 1982. Production began to turn up, and prices soon followed. Production in 1982 fell slightly from 1981, according to estimates by the U.S. International Trade Commission. However, other estimates from the Society of the Plastics Industry, slightly lower, put production for both years about the same.

For 1983, early estimates of first-quarter production are up substantially as are estimates for end-use polyurethanes. Although the first-quarter rates likely won't be maintained for the year, analysts still put TDI's 1983 production up 10 to 15% over 1982 to perhaps 650 million lb. This volume is about the maximum possible from nameplate capacity of about 700 million lb a year. Usually, effective top capacity in TDI runs below that of most other major organic chemicals as a percentage of nameplate because of the complexity of the several processing and purification steps.

The ITC estimate of TDI first-quarter production was up more than 14% over first-quarter 1982, suggesting that U.S. capacity was running just about all out. If 1983 production does total 650 million lb, capacity will have to run at an average of nearly 93% of the nameplate total—very high for TDI. No additions to capacity will be coming this year except for some possible small gains through plant debottlenecking. So producers could be faced with a year-long scramble to meet demand—a situation not faced by any major segment of the chemical industry in a long time.

Part of the reason for the high operating rate in the first quarter came from producers' plans to end discounts from the list price of 93 cents a lb for the standard 80/20% mixture of TDI isomers. Major consumers of TDI—makers of polyurethane foams—also saw recovery coming for their products. So inventory building began in at least two levels of the consumption chain, with the objective of improving future profitability by beating a TDI selling price increase.

This inventory building program could be an asset later in 1983 when the full impact hits from the big increase in housing starts. When buyers of new homes start moving in, they will be looking for furniture, which consumes 40% of flexible polyurethane foams, the type made from TDI. Presumably, all of the foam needed by furniture markets will be available.

The same assumption applies to the second largest flexible foam outlet, autos. Although auto production has not yet recovered as well as some industry observers forecast, a somewhat wider use of polyurethane foams in autos and the pickup in large-sized car sales add up to an upswing in polyurethane demand.

Bedding, the third largest use of flexible foams, also will cash in on the housing recovery. It and other housing uses such as carpet backings and underlays likely will increase strongly and will further press TDI capacity limits.

The small TDI uses such as coatings and elastomers also will participate in the economic recovery and push up demand. However, these uses are so minor that even relatively big gains will not affect TDI demand much.

TDI's booming export business this year is expected to at least match the 1982 level of about 190 million lb, barring a capacity squeeze. One caveat is the strong dollar, which could make exports less desirable to customers abroad than at home. However, if as expected the economies of the rest of the world improve following improvement in the U.S., demand could push up export prices just the same. If not, U.S. consumers might get a tad of relief in supply and price pressure.

In other words, TDI has its best year in store in a long time. The shakeout it went through in producers and capacity at the turn of the decade is now having a highly beneficial effect on this business. Producers have kept their restraint on capacity expansion and simply waited for better days. That kind of patience has now paid off, thanks to some nice surprises in leading markets.

Global Methanol Overcapacity Will Get Worse

Capacity will exceed demand by 21% in 1983 and widen to 29% by 1985, primarily because fuel markets haven't developed as expected

Earl V. Anderson, C&EN New York

The world methanol situation is going to get worse before it gets better. World capacity, which this year exceeds demand by 21%, will rise to 29% above world demand by 1985.

After that, capacity relative to demand will get better—but not much better. Surplus capacity will shrink, but still will hover around 21% above world demand. That will put methanol producers right back to where they are now.

That's how A. E. "Sam" Egglestone, senior vice president of Alberta Gas Chemicals Ltd., sees the world methanol picture developing over the next five years. "It's not a pretty picture," Egglestone said at a meeting of the Chemical Institute of Canada (CIC) in Calgary, Alta.

It is particularly not pretty for Canada. Three companies—Alberta Gas Chemicals, Celanese Canada, and Ocelot Industries—have worldscale methanol plants in Canada with a combined capacity of 1.8 million metric tons per year. That's more than a four-fold increase since 1980. And Canadian demand, which will rise from 230,000 metric tons this year to 340,000 metric tons by 1988, pales by comparison. Obviously, says Egglestone, Canadian methanol producers have to export. But they will have to do it into a head wind of worldwide oversupply.

Egglestone lays the blame for the bind that methanol producers are in squarely on overly optimistic projections on methanol's use in fuel. The recession no doubt has had an impact on methanol's misfortunes, but not nearly so much as fuel markets not developing as expected.

During past oil crises, fuel methanol was seen as one of the best solutions to the energy problem. Market researchers, confident that fuel was a market for methanol whose time had come, turned out glowingly optimistic reports.

Companies, especially those in areas with low-cost natural gas such as Canada and the Middle East, jumped on the methanol bandwagon. Even if the fuel market didn't catch on, they felt that their low-cost feedstock base would enable them to capture a share of traditional methanol markets.

Instead, Egglestone estimates that fuel uses will account for no more than 10% of world methanol consumption this year. Even by 1988, fuel's share of the methanol market will be only about 22%, he says.

As a result, methanol producers will have to contend with surplus capacity for some time. To make matters worse for Canadian producers, the most serious methanol supply-demand imbalance is in North America—that is, the U.S., Canada, and Mexico. This area will account for 88% of the world methanol surplus this year. And, although the North American situation will improve, the region still will have more than half of the world surplus in 1985 and more than a third in 1988.

The two other areas that will have huge overcapacities in methanol are East Europe, where the Soviet Union is emerging as a major supplier, and the Africa-Middle East region, particularly Saudi Arabia.

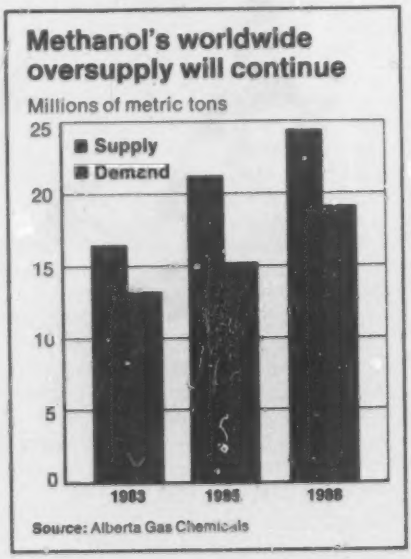
Fortunately for methanol producers, there are some areas that are or will have short supplies of methanol. Right now, the Pacific Basin and Southeast Asia are the biggest deficit areas. The methanol shortage there will shrink, however, as new units are brought on stream in southeast Asian countries.

Western Europe, already short on methanol, will emerge with the largest shortfall by 1988. And the U.S., which now has substantial overcapacity in methanol, will require some imported material by 1988, says Egglestone.

These developments indicate how methanol trade patterns will change over the next few years. The methanol-rich areas will be fighting for markets in the methanol-poor regions. Unfortunately, it will be a case of too many horses maneuvering for too few stalls.

This will put a lot of pressure on Canadian producers. Even without the huge 2 million-metric-ton plant proposed by Biewag Energy Resources (which Egglestone doesn't think will be built), the industry can never expect Canadian demand to soak up available supply.

Methanol's worldwide oversupply will continue



Source: Alberta Gas Chemicals

To the south, the U.S. now has a 1.2 million-metric-ton surplus. But Egglestone expects that the U.S. will require 380,000 metric tons of imports by 1988.

Still, that's a small target for a country that will have 1.5 million metric tons more methanol than it will need in 1988. Besides, Canadian producers may have to contend with competition from Mexico, if that country is able to get its economic act back together.

Western Europe will be the most attractive target for methanol exporters. Based on existing supply-demand estimates, Western Europe already is about 310,000 metric tons short on methanol. This shortage will soar to 1.3 million metric tons by 1988, says Egglestone.

However, both Eastern Europe producers and producers in Africa and the Middle East will be strong contenders to make up the western European shortfall. Canadian producers will be hard-pressed to meet this competition.

In East Europe, the Soviet Union is emerging as the dominant methanol supplier. Two new plants, at Gubaha and Tomsk, each with a capacity of 2500 metric tons per day, will push Soviet capacity up from 1.9 million metric tons this year to 3.55 million metric tons in 1988. Other huge increases are slated for East Germany and Yugoslavia.

In Africa and the Middle East, Saudi Arabia has two, 2000 metric-ton-per-day units planned that will double capacity to 1.2 million metric tons per year. The United Arab Emirates, Libya, and Bahrain also will become big methanol producers.

Excluding Mexico, which will have more methanol than it will know what to do with, Latin American supply and demand will be virtually in balance. This, then, leaves the Pacific Basin and Southeast Asia as major outlets for Canadian methanol.

Japan now is the major methanol producer in the region. But Japanese producers can't compete with the new, low-cost lineup. They are shutting down plants and will rely increasingly on imports.

However, new capacity will be built in other parts of the region. A new, 1200 metric-ton-per-day plant, half owned by Alberta Gas, will be on stream this year. By 1988, additional capacity should be on stream in Indonesia, Malaysia, and Burma. There are some doubts, however, about the Indonesian plant.

Still, the Pacific Basin-Southeast Asia region will become more self-sufficient in methanol over the next five years. Egglestone sees the region's deficit falling from 700,000 metric tons to only 110,000 metric tons by 1988. This, too, is a small target for methanol-rich exporters, and Canadian producers will face strong competition for the market from the Middle East.

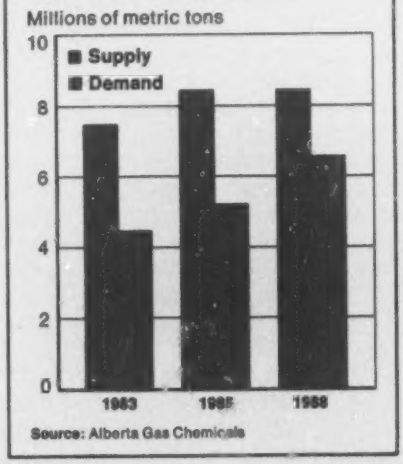
What would help Canadian methanol producers—indeed, all producers—is for the fuel market to develop as anticipated a few years ago. But how it will, in fact, develop is anybody's guess, says Egglestone.

Canada's methanol supply far exceeds demand

Thousands of metric tons	1983	1985	1988
Effective supply[a]	1810	1810	1810[b]
Alberta Gas Chemicals	720	720	720
Celanese Canada	690	690	690
Ocelot Industries	400	400	400
Domestic demand	230	255	340
Surplus	1580	1555	1470

a Estimated at daily capacity × 330. b Does not include proposed Biewag plant. Source: Alberta Gas Chemicals

Methanol glut in North America will persist



Source: Alberta Gas Chemicals

Certainly fuel methanol—that is, low-level blends of up to 5% methanol in gasoline, high-level blends of up to 12%, and "neat" methanol containing 85% or more—has its advantages. More than 2 barrels of crude are backed out of fuel demand for every barrel of methane used. A 5% methanol-gasoline blend increases road octane by two points. This can be significant for countries facing lead phasedown. Egglestone says that methanol fuel demand likely will be helped next month when the U.S. goes to 1.1 g per gal of lead.

However, fuel methanol has many problems, most of which are solvable but which are holding up methanol fuel development nonetheless. One major problem is that cosolvent alcohols—C-3s and C-4s—must be used with methanol blends. These alcohols sell for about $2.00 per gal, whereas methanol is about 50 cents, according to Egglestone. Thus, economics are a problem. And, he adds, the limited availability of these cosolvent alcohols places an upper limit in the amount of methanol that can be used in fuel. And, of course, today's relatively low crude oil prices aren't helping methanol's cause much.

Still, the outlook for methanol in fuel could change abruptly, says Egglestone. An increase in crude prices could put methanol fuel in a better light. Incentives, such as the tax breaks given to methanol fuel by several states in the U.S., also could help. In Canada, prospects for such incentives "are just about zero," says Egglestone.

He suggests that the best way to go may be to convert methanol directly into gasoline, rather than blend it in. Everyone is watching New Zealand, where a 4400 metric-ton-per-day unit is dedicated to gasoline using the Mobil process.

Egglestone points out that the biggest energy penalty in the methanol-to-gasoline process is in producing methanol from natural gas. The methanol-to-gasoline step is less energy intensive. Because this approach avoids many of the problems associated with methanol fuel blends, the smaller additional energy penalty may be worth paying, he says.